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(58) Field of search
UK CL (Edition J) H1D DK
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(71) Applicant
Hitachi Ltd

(Incorporated in Japan)

6 Kanda Surugadai 4-chome, Chiyoda-ku, Tokyo, Japan

(72) Inventors
Toshio Ogura
Masumi Kuga

(74) Agent and/or Address for Service
J A Kemp and Co
14 South Square, Gray's Inn, London, WC1R 5EU, United Kingdom

(54) Magnetron

(57) A magnetron comprises a cylindrical anode 1 having a plurality of anode vanes 2 extending radially around the axis of the anode, and two strap rings 20, 20' of the same structure are disposed angularly displaced around the anode axis to connect respective sets of alternate anode vanes. As shown in Fig. 6 each ring may have alternate inner and outer upwardly bent tongues 21, 22, with the total number of tongues on each ring being equal to half the number of vanes, and the two rings are located back-to-back, Fig. 9 (not shown), to effect connection to the appropriately shaped cut-outs in the respective vanes. Since the two rings are identical adjustment thereof to stabilize the oscillation frequency is facilitated. Alternate ones of the anode vanes are connected together by one of the strap rings. The remaining anode rings are connected together by the other strap ring. The two strap rings are displaced circumferentially each other by a given angle centering around the axis of the anode.

FIG. 6

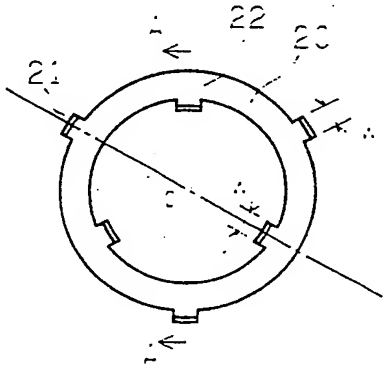

FIG. 8

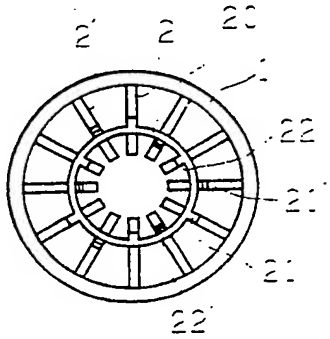

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FIG. 1
PRIOR ART

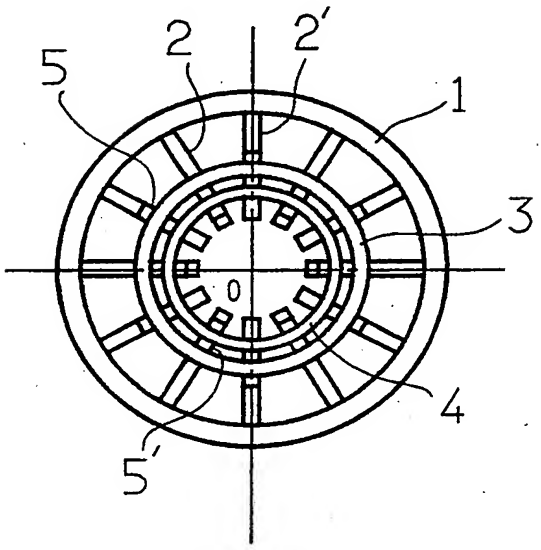


FIG. 2
PRIOR ART

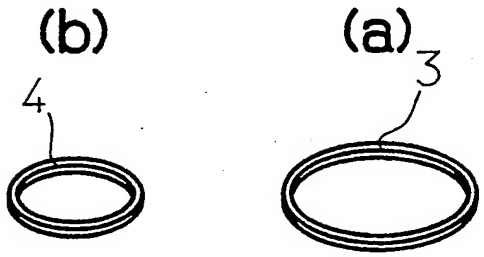


FIG. 3
PRIOR ART

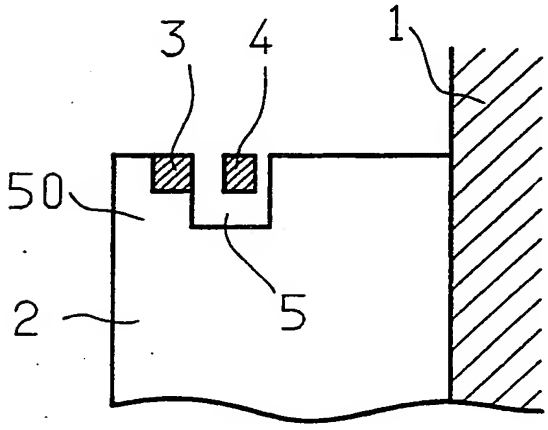


FIG. 4
PRIOR ART

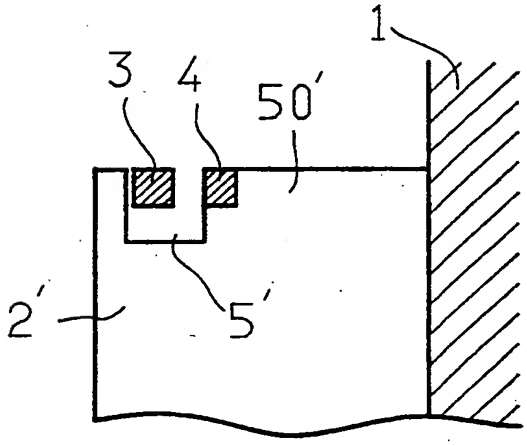


FIG. 5

PRIOR ART

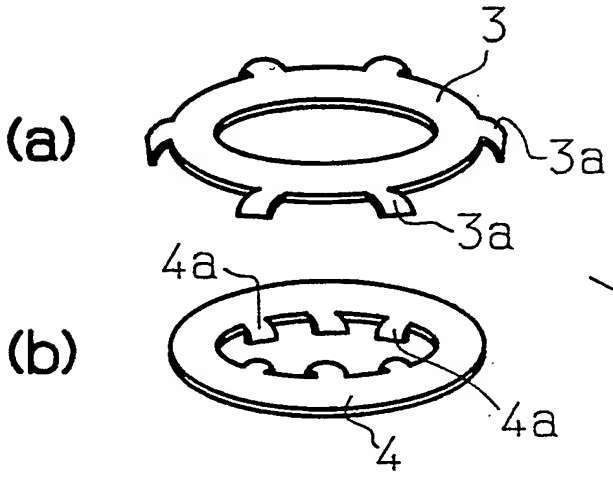


FIG. 6

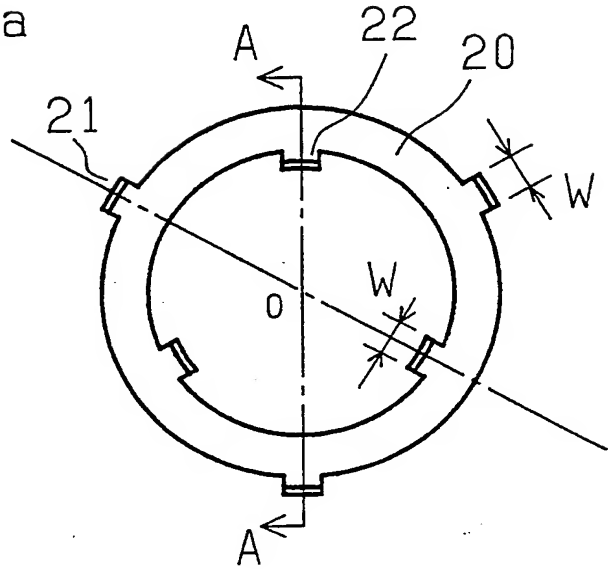


FIG. 7

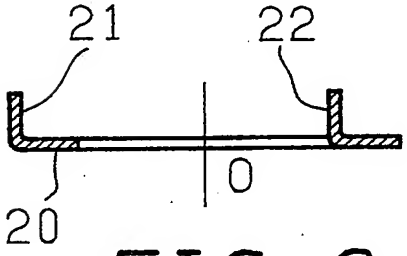


FIG. 8

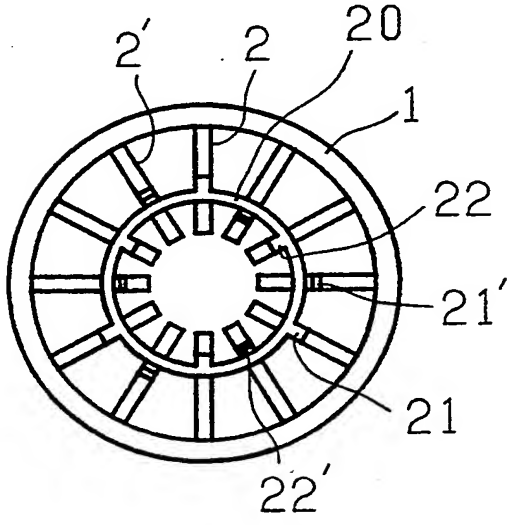
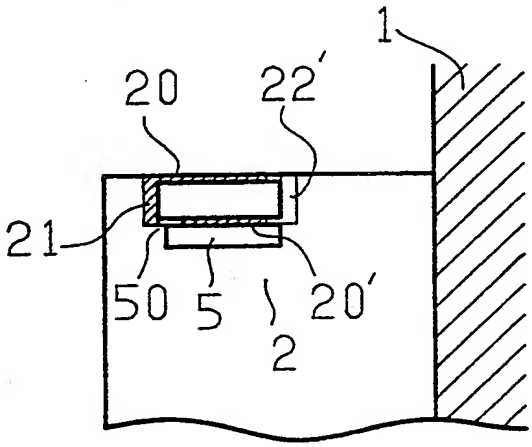


FIG. 9



MAGNETRON

FIELD OF THE INVENTION

The present invention relates to a magnetron and, more particularly, to a magnetron the oscillation frequency of which can be easily adjusted and which is equipped with strap rings that are easy to fabricate.

BACKGROUND OF THE INVENTION

A magnetron which is frequently used as an RF wave source has a plurality of anode vanes on its anode. Alternate anode vanes are electrically connected together to form plural resonant cavities, as disclosed in US. Pat. No. 3,553,524.

To connect together alternate anode vanes, cutouts are formed at the side fringes of the vanes, and two rings of different diameters are inserted in the cutouts. The rings are joined to the fringes of alternate cutouts in the anode vanes.

Fig. 1 is a plan view of main portions of a conventional magnetron. This magnetron comprises an anode 1, anode vanes 2, 2', a first strap ring 3, a second strap ring 4, and cutouts 5, 5' formed at the fringes of the anode vanes. The anode vanes 2 and 2' extend toward the center $\overline{0}$ from the inner wall of the anode 1. The anode vanes are arranged radially around the axis passing through the center

0. The alternate anode vanes 2 are connected together by the first strap ring 3, while the remaining anode vanes 2' are connected together by the second strap ring 4 that is different in diameter from the first ring 3.

Fig. 2 is a perspective view of the strap rings. The larger one is the first strap ring 3. The smaller one is the second strap ring 4.

Figs. 3 and 4 are side elevations of the anode vanes and the strap rings, for showing their connection. Fig. 3 shows the manner in which the anode vanes 2 (only one is shown) are connected together by the larger first strap ring 3. A cutout 5 is formed at each side fringe of the anode vane 2. One side wall of the cutout 5 is defined by a step 50 over which the first strap ring 3 fits.

Fig. 4 shows the manner in which the anode vanes 2' (only one is shown) are tied together by the smaller second strap ring 4. A cutout 5' is formed at each side fringe of the anode vanes 2'. One side wall of the cutout 5' is formed by a step 50'. The second strap ring 4 fits over the step 50. In this way, the alternate anode vanes 2 are connected together. Also, the alternate anode vanes 2' are connected together.

Fig. 5 is a perspective view of another known set of strap rings. In this figure, (a) shows the first strap ring, while (b) shows the second strap ring. The first ring

3 has the same diameter as the second ring 4. A plurality of outer tongues 3a are formed on the outer periphery at positions corresponding to the positions of alternate anode vanes. The tongues 3a protrude from the outer periphery, and are bent in one direction. Inner tongues 4a are formed on the inner surface of the second strap ring 4 at positions corresponding to the remaining anode venes. The strap rings 3 and 4 are fitted in the cutouts 5 and 5', respectively, formed in the anode venes 2 and 2', respectively, to couple together alternate anode vanes. The oscillation frequency is determined and the operation is stabilized by adjusting the electrostatic capacitance between the first strap ring and the second strap ring.

In the aforementioned prior art techniques, it is necessary to fabricate the first and second strap rings as separate parts. It is difficult to adjsut the oscillation frequency and to stabilize the operation with two strap rings of different diameters or shapes. Further, fabricating two kinds of strap rings increases the cost of the parts.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a magnetron which is free from the foregoing problems of the prior art techniques. The present invention makes it easy adjsut the oscillation frequency and stabilize the

operation, and is equipped with strap rings that are economical to fabricate.

The above object is achieved by a magnetron having two strap rings of the same construction, the strap rings being disposed in a back-to-back relation to couple together alternate anode vanes and to couple together the remaining anode vanes, each strap ring having n tongues protruding inward and outward alternately, the tongues being formed corresponding to the positions of the anode vanes.

Generally, the number of n is 8 or more. The tongues which protrude from the inner surface and the outer surface of a ring are spaced $360^{\circ}/n$ from each other and bent through about 90° from the plane of the ring.

In order to connect together alternate ones of the n anode vanes and to connect together the remaining anode vanes, two strap rings of the same construction are used. Each strap ring has n/2 tongues on its outer surface and n/2 tongues on its inner surface. These tongues are arranged radially around the center $\overline{0}$ of the ring such that the outer tongues alternate with the inner tongues. The two strap rings are arranged in a back-to-back relation with a gap therebetween. The strap rings are so mounted that the tongues are fitted in the cutouts formed in the anode vanes. The electrostatic capacitance between the two strap rings is adjusted and the oscillation frequency is set by adjusting

the space between the two strap rings. Since the two used strap rings have the same construction, the oscillation frequency can be easily adjsuted. Also, the stability of the operation is improved. Further, the cost of the strap rings can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a plan view of main portions of a conventional magnetron;

Fig. 2 is a perspective view of a known set of strap rings;

Figs. 3 and 4 are side elevations of main portions of anode vanes and strap rings, for showing the manner in which they are connected by the prior art techniques;

Fig. 5 is a perspective view of another conventional set of strap rings;

Fig. 6 is a plan view of a strap ring for use in a magnetron according to the invention;

Fig. 7 is a cross-sectional view taken on line A-A of Fig. 6;

Fig. 8 is a plan view of anode vanes connected together by strap rings according to the invention; and

Fig. 9 is a cross-sectional view of a portion of a magnetron in which anode vanes are connected together by strap rings according to the invnetion.

DETAILED DESCRIPTION OF THE INVENTION

Referring to Fig. 6, there is shown a strap ring for use in a magnetron according to the invention. The strap ring, generally indicated by numeral 20, is annular in form and has outer tongues 21 and inner tongues 22. The total number n of the tongues 21 and 22 is equal to the half of the number of the anode vanes. The number of the outer tongues 21 is n/4. Also, the number of the inner tongues 22 is n/4. The tongues 21 and 22 are circumferentially spaced $2 \times 360^{\circ}/n$ from each other. Of course, the anode vanes are spaced $360^{\circ}/n$ from each other. The width w, or the circumferential dimension, of each of the outer tongues 21 and the inner tongues 22 is made substantially equal to the wall thickness of each anode vane. If the width w of each tongue is considerably smaller than the wall thickness of each anode vane, then flow of heat between the strap ring and each anode vane is hindered. Conversely, if the width w of each tongue is considerably larger than the wall thickness of each anode vane, then it is difficult to electrically insulate the tongues of the strap ring from the anode vanes or to insulate the tongues of one strap ring from the tongues of the other strap ring.

Fig. 7 is a cross-sectional view taken on line A-A of Fig. 6. The outer tongues 21 and the inner tongues 22 are bent through about 90° from the plane of the strap ring 20 and extend in the same direction.

Fig. 8 is a plan view of a magnetron in which anode vanes are connected together by strap rings according to the invention. The magnetron comprises an anode 1, anode vanes 2, 2', a first strap ring 20, and a second strap ring 20' which is also shown in Fig. 9. The first ring 20 has outer tongues 21 and inner tongues 22. The second ring 20' has outer rings 21' and inner rings 22'.

Fig. 9 is a cross-sectional view of a portion of a magnetron in which anode vanes are connected together by strap rings according to the invention. Shown in this figure are an anode 1, an anode vane 2, a cutout 5 formed at a side fringe of the vane 2, a first strap ring 20, and a second strap ring 20'. The first ring 20 has an outer tongue 21. The second ring 20' has an inner tongue 22'. The second ring 20' has the same structure as the first ring 20 but is inverted. The two strap rings 20 and 20' are disposed in a back-to-back relation with a gap therebetween.

In Fig. 9, the outer tongue 21 of the first strap ring 20 is coupled to a step 50 formed outside of the cutout 5 in the anode vane 2. The inner tongue 22' of the second strap ring 20' is coupled to a step (not shown) formed in the cutout created in a neighboring anode vane. Thus, alternate ones of n anode vanes 2 are connected together by the n/2 outer tongues. The remaining anode vanes are tied together by the n/2 inner tongues.

After the strap rings having the same shape are coupled to the anode vanes, the oscillation frequency of the magnetron is set and the operation is stabilized by adjusting the space between the first strap ring 20 and the second strap ring 20' or their positional relation.

As described thus far, alternate anode vanes are connected together by a first strap ring, the remaining anode vanes being connected together by a second strap ring having the same structure as the first ring. Therefore, the two strap rings are standardized. This leads to a reduction in the cost. Further, since the two strap rings have the same shape, it is easy to adjsut the oscillation frequency and to stabilize the oscillation. Hence, a magnetron which is free of the foregoing problems and has excellent functions can be offered.

CLAIMS

1. A magnetron comprising:

a cylindrical anode;

a plurality of anode vanes which are formed upon the inner wall of the anode and arranged radially around the axis of the anode, the anode vanes being provided with cutouts at their side ends;

a first strap ring by which alternate ones of the anode vanes are connected together at the position of their respective cutouts; and

a second strap ring by which the remaining anode vanes are connected together at the positions of the respective cutouts, the second strap ring having the same shape as the first strap ring, the first and the second strap rings being displaced circumferentially each other by a given angle centering around the axis of the anode.

2. A magnetron comprising:

a cylindrical anode;

a plurality of anode vanes which are formed upon the inner wall of the anode and arranged radially around the axis of the anode, the anode vanes being provided with cutouts at their side ends;

a first strap ring by which alternate ones of the anode vanes are connected together at the positoins of their respective cutouts; and

a second strap ring by which the remaining anode vanes are connected together at the positions of the respective cutouts, each of the first and second strap rings having inner tongues and outer tongues, the inner tongues alternating with the outer tongues, the inner tongues of each strap ring protruding from the inner surface of the strap ring and bending in one direction, the outer tongues of each strap ring protruding from the outer surface of the strap ring and bending in said one direction, the inner and outer tongues being so arranged that each one tongue corresponds to one anode vane, the inner and outer strap rings being disposed in a back-to-back relation with a gap therebetween and fitted in the cutouts, the outer tongues of one strap ring engaging with alternate ones of the anode vanes, the inner tongues of the other strap ring engaging with the remaining anode vanes.

3. The magnetron of claim 2, wherein the width, or the dimension taken circumferentially of the strap ring, of each of the iner and outer tongues is set substantially equal to the wall thickness of each anode vane.

4. A magnetron constructed and arranged substantially as hereinbefore described with reference to and as illustrated in Figures 6 to 9 of the accompanying drawings.

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